In the Claims

12. (amended) A method for the production of nanomaterial particles comprising the steps of:

synthesizing nanomaterial particles in solutions of complex liquids from suitable precursors, which precursors are selected from the group consisting of suitable surfactants, alkoxides, and metal salts, by a suitable chemical reaction under mild conditions; and

preparing fine colloids dispersed in various polymer solutions.

27 (amended) A method according to claim 12, wherein the precursors are selected from the group consisting of triethoxy silanes (TEOS); trimethoxy silane (TMOS); Al and Zr isopropoxides; Fe, Mg and Al chlorides; Al and Mg acetates; Na and K orthosilicates; Zr oxychloride; and transition metal salts of Fe, Co, Ni, Cu, Ru, Rh, Pd, Ir, and Pt.

REMARKS

In the Office Action mailed February 26, 2002, the Examiner rejected claims 12-30 of the present invention. The Examiner rejected claims 12-19, 22, 24, 25, and 27 under 35 U.S.C. §102(e) as being anticipated by, or in the alternative, under 35 U.S.C. §103(a) as obvious over U.S. Patent No. 5,938,934 to Balogh et al. ("Balogh"). The Examiner also rejected claims 19, 20 and 26 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of U.S. Patent No. 5,147,841 to Wilcoxon. The Examiner rejected claims 19, 20, 23, and 26 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of U.S. Patent No. 5,879,715 to Higgins et al. The Examiner rejected claims 19, 20, 23, and 26 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of U.S. Patent No. 6,228,904 to Yadav. The Examiner rejected claims 29 and 30 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of U.S. Patent No.6,090,858 to El-Sayed. The Examiner rejected claims 12-30 under 35 U.S.C. §112, first paragraph, because the specification fails to provide enablement for synthetic resins. The Examiner rejected claims 12, 13 and 27 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter of the

invention. The Examiner also requires that priority data be included in the application.

In view of the amendments and remarks set forth herein, Applicants respectfully submit that all pending claims 12-30 are in condition for allowance.

A. Priority Data Objection

The data indicating the priority claim to PCT/IL99/00097 has been added to the specification.

B. Rejection under §102(e)

Claims 12-19, 22, 24, 25 and 27 were rejected by the Examiner under 35 U.S.C. §102(e) as being anticipated by, or in the alternative, under 35 U.S.C. §103(a) as obvious over Balogh. The Examiner stated that Balogh discloses the instantly claimed method for producing nano-material particles. The Examiner states that, as to claim 15, the water used in Balogh would be "nonfreezing" because of its electrolyte content. The Examiner also states that although Balogh does not disclose particles having the size range 1-5 mm, it would have been obvious to control reaction conditions in Balogh to obtain such particles if desired.

Applicants submit that the presently claimed subject matter is patentably distinguishable from Balogh and, further, that the claimed subject matter is not anticipated by Balogh. In order to properly reject a claim under §102, each and every element of the claimed subject matter must be disclosed in a single prior art reference. *In re Paulsen*, 31 USPQ2d 1671 (Fed. Cir. 1994). Claim 12, from which all of the other claims in the application ultimately depend, recites a method for the production of nanomaterial particles in which the nanomaterial particles are synthesized from precursors in solutions of complex liquids and dispersed in various polymer solutions to form colloids. As defined on page 1, paragraph 1 of the specification, the "nanomaterials" refer to transition metals and alloys, metal oxides, and ceramic compositions having a size of from about 1-6 nm.

Balogh, on the other hand, discloses the production of silicon-containing dendrimer based networks prepared from copoly (amidoanrine-organosilicon) (PAMAMOS) dendrimers or a copoly (propyleneimine-organosilocon).

Balogh indicates that these networks may then be used as molecular sponges for encapsulating or entrapping various metal cations or elemental metal or as confined nanoscopic reactors for physico-chemical reaction of encapsulated species. Although Balogh does disclose polymer solutions having metal or metal complex groups, its method of preparation is completely different from that disclosed in the present application. In Balogh, the PAMAMOS dendrimer is simply mixed with a metal containing precursor (e.g. copper acetate in Example 13). The metal ions in the precursor then complex with the ligating sites of the PAMAMOS dendrimer forming nanoscopic metal composites in the dendrimer network.

In the present application, on the other hand, the nanomaterial particles are synthesized in water organic-surfactant organized solutions. The nanomaterial particles are then mixed with polymer solutions to form fine colloids. Balogh completely fails to disclose or suggest a method of forming nanomaterial particles comprising metals and alloys, metal oxides or ceramic from precursors in complex liquids. In addition, Balogh fails to teach or suggest the formation of colloid dispersions of these nanomaterials, and instead only teaches the entrapping of metal composites in the dendrimer network.

Further, and with respect to claim 13, the Examiner claims that the water used in Balogh would be nonfreezing "because of its electrolyte content". Applicants respectfully submit that whether water contains electrolytes is not dispositive of whether it is "nonfreezing", as that term is used in the present application. As used in the present application, "nonfreezing" water is defined as strongly bound water having no peaks or thermograms down to -100°C (pg. 3, second paragraph). Balogh does not teach or suggest the presence of this strongly bound "nonfreezing" water.

With respect to claim 14, the Examiner states that "while examples of Balogh et al may not specifically disclose nano-material particles having the size range of 1-5 nm, it would have been obvious to one skilled in the art...to control reaction conditions...in the Balogh et al method to obtain nano-material particles in the range of 1-5 nm when the ultimate intended use makes such small particles necessary or desirable" (Office Action, pg 2-3). What support does the Examiner have for making this statement? The Examiner provides no support for this claim

either in Balogh or prior art. The applicants submit that it is improper for the Examiner to make such a statement without any support for such a claim. As described in the present application, one must regulate the water content such that the whole water is strongly bound (non-freezing) in order to provide nano particles having a diameter of less than 5 nm (page 3, item b).

As such, Balogh clearly fails to teach or suggest all of the elements of claim 12 (and thus dependent claims 13-30). Applicants therefore respectfully request that the Examiner remove the rejections of claims 12-19, 22, 24, 25 and 27 over Sugimoto under 35 U.S.C. §102(e) and/or §103(a).

C. Rejections Under §103(a)

1. Rejection of Claims 19, 20 and 26 Over Balogh in View of Wilcoxon

The Examiner rejected claims 19, 20 and 26 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of Wilcoxon. The Examiner argued that Balogh met all of the claimed limitations of claims 19, 20 and 26, except for the limitation of using a microemulsion or the use of DDAB.

Applicants submit that claims 19, 20 and 26 are patentable over Balogh in view of Wilcoxon. First, there is no motivation to combine the two references. Applicants submit that if the Examiner is relying on an obviousness type rejection, the Examiner must comply with the requirements for establishing obviousness as set forth in *Graham v. John Deere Co*, 383 U.S. 1, 17-18 (1966), which are summarized in the MPEP at section 706.02(j) as follows:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves of in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitation. The teachings or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not in the applicant's disclosure. *In re Vaech*, 947 F. 2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991).

In order for an invention to be obvious over a prior art reference, it has been held that the prior art reference *itself* must suggest the desirability for the modification to be considered an obvious prior art reference. *In re Fritch,* 92 F. 2d 1260, 23 U.S.P.Q. 2d 1780 (Fed. Cir. 1992)(emphasis added). Here, the prior art references fail to individually teach all of the claimed features explicitly. Further, and more importantly, the Examiner has failed to identify any teaching found *in the prior art references* which would provide a person of ordinary skill in the art with the motivation to combine the individual teaching disclosed in the separate references. In this respect, the two references that the Examiner is attempting to combine are concerned with completely non-analogous fields of art. Wilcoxon is concerned with the formation of metal colloids while Balogh is concerned with dendrimer based networks with or without nanoscopic composites entrapped therein. As such, the advantages described in Wilcoxon obtained by using a cationic surfactant in its method cannot be extrapolated to the methods described in Balogh. Wilcoxon describes that the use of such surfactants prevents aggregation of the colloidal metal particles. As described earlier, Balogh does not teach the formation of colloids. Rather, it teaches the complexation of nanoscopic composites in a dendrimer network. The two processes are non analogous and thus it is impermissible to combine the teachings of the two references without some explicit motivation to do so.

Even if one could combine the two references, such combination would still not render present claims 19, 20 and 26 unpatentable. As described above, Balogh fails to teach the formation of nanomaterial particles in solutions of complex liquids and the subsequent dispersing of the particles in polymer solutions to form colloids. These limitations are present in claims 19, 20 and 26, which ultimately depend on claim 12. With regard to claim 19, neither Balogh nor Wilcoxon describe the use of organized water-organic surfactant.

As such, Applicants respectfully request that the Examiner remove this rejection.

2. Rejection of Claims 19, 20, 23 and 26 over Balogh in View of Higgins

The Examiner rejected claims 19, 20 and 26 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of Higgins. The Examiner argued that

Balogh met all of the claimed limitations of claims 19, 20, 23 and 26, except for the limitation of using a microemulsion including CTAB and octane.

The combination of Balogh and Higgins fails to render the noted claims unpatentable for the same reasons outlined above that the combination of Balogh and Wilcoxon did not. That is, there is no motivation to combine the two references. While both broadly are concerned with the formation of nanoparticles, Balogh and Higgins describe methods and products that are completely dissimilar. The teaching of Balogh are described above. Higgins teaches a method for forming inorganic nanoparticles by precipitating inorganic nanoparticles in a micellar phase in a microemulsion and subsequently concentrating the nanoparticles via ultra-filtration. It does not teach or suggest the entrapment of metal composites in a dendrimer based network. Higgins and Balogh use completely different methods to form completely different products. To pick and choose teachings from two such disparate references without some motivation to do so is improper.

Applicants are puzzled by the Examiner's assertion that it would have been obvious to one skilled in the art to use a microemulsion including CTAB and octane in the method of Balogh to realize the advantage of low related production costs taught by Higgins in col. 4, lines 41-43. Higgins teaches the use of two microemulsions to form a new microemulsion in which equilibration of the solutes within the micelles causes precipitation reactions to form product nanoparticles. (col. 6, lines 1-15). The use of microemulsions is not necessary in Balogh and, in fact, would most likely be counterproductive to the formation of the nanocomposite bonded PAMAMOS dendrimer network described therein. How would the use of a microemulsion in Balogh reduce the cost associated therewith? It seems that the Examiner is merely picking and choosing various teachings from the cited references in order to meet the limitations of the claimed invention without any motivation to combine the references or even any indication that the teachings of one are relevant to the other.

3. Rejection of Claim 28 over Balogh in View of Yadav

The Examiner rejected claim 28 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of Yadav. The Examiner argued that Balogh met all of the claimed limitations of claim 28 except for the limitation of using a PMMA.

The combination of Balogh and Higgins fails to render the noted claims unpatentable for the same reasons outlined above that the combination of Balogh and Wilcoxon did not. That is, there is no motivation to combine the two references and, even if the references could be combined, such a combination would still meet all the features of claim 28. The Examiner states that "while Balogh does not disclose the use of PMMA, it would have been obvious to one skilled in the art...to use the PMMA of ex. 3 of Yadav et al in the method of ex. 16 of Balogh et al so that said PMMA forms a matrix for the nanoscopic metal composites of Balogh et al., thus preparing an ultimate product having desired electrical properties such as resistivity." The applicant's are puzzled by this statement. Is the Examiner suggesting the substitution of PMMA for the PAMAMOS dendrimer network described in Example 16 in Balogh? Nanoscopic composites are formed in Example 16 when the copper ions complex with the nitrogen ligating sites of the PAMAMOS dendrimer interior. PMMA has no such nitrogen ligating sites. Thus, the substitution of PMMA for PAMAMOS in Balogh would be unlikely to form nanocomposites. In addition, the use of PMMA in Yadav does not alone impart the desired electrical properties such as resistivity to the nanostructured filled polymer matrix. Thus, the Examiner cannot state that it would have been obvious to substitute PMMA in the Examples of Balogh. There is simply no motivation to combine the teachings of the two references.

4. Rejection of Claims 29 and 30 over Balogh in View of El-Sayed

The Examiner rejected claims 29 and 30 under 35 U.S.C. §103(a) as being unpatentable over Balogh in view of El-Sayed. The Examiner argued that Balogh met all of the claimed limitations of claims 29 and 30 except for the limitation of using hydrogen as a reducing agent.

The Examiner states that "while Balogh [does] not disclose the use of hydrogen as a reducing agent, it would have been obvious to one skilled in the art...to use hydrogen of El-Sayed (abstract) in lieu of hydrazine in Ex. 16 of Balogh". Even assuming for the purpose of argument that this is true, such a combination would still not render claims 29 and 30 unpatentable. As outlined above while discussing the §102 rejection, Balogh (including Ex. 16) fails to teach or disclose numerous features recited in claims 29 and 30 (which contain all of the limitations of

claims 12 and 17), including the use of nanomaterial particles synthesized in solutions of complex liquids or the preparation of colloid dispersions in polymer solutions.

For at least the above reasons, the applicants request that the Examiner remove all pending §103(a) rejections.

D. Rejection Under 35 U.S.C. §112, First Paragraph

The Examiner rejected claims 12-30 under 35 U.S.C. §112, first paragraph because the specification allegedly does not reasonably provide enablement for synthetic resins as the nanomaterial. The applicants are puzzled by this rejection. The applicants have not claimed the nanomaterial as being comprised of synthetic resin. As defined on page 1 of the specification, first paragraph, "nano-materials" in connection with the present invention comprise transition metals and alloys; metal oxides; and ceramic compositions. It is true that the nanomaterials thus synthesized are dispersed in polymer solutions to form colloids, but the applicants are not claiming that the nanomaterials themselves comprise synthetic resins. Thus, applicants request that the Examiner remove this objection.

E. Rejection Under 35 U.S.C. §112, Second Paragraph

The Examiner rejected claims 12, 13 and 27 under 35 U.S.C. §112, second paragraph for failing to particularly point out and distinctly claim the subject matter which applicants regard as their invention. Specifically, the Examiner rejected claim 12 as failing to recite a number of precursors in a Markush group. The Examiner rejected claim 13 as vague as to the scope of the term "nonfreezing water". The Examiner rejected claim 27 for failing to provide antecedent basis for some of the named components.

With regard to the rejection of claim 12, that claim has now been amended to recite the precursors in Markush group format.

With respect to claim 13, applicants submit that the metes and bounds of the term "nonfreezing water" is adequately defined in the specification. In order to meet the description requirement of §112, first paragraph, the specification "must...convey with reasonable clarity to those skilled in the art that...[the inventor]

was in possession of the invention." Vas-Cath v. Mahurkar, 19 USPQ2d 1111, 1117 (Fed. Cir. 1997). The Examiner will note that on page 3, paragraph 2 of the specification, the applicants define "nonfreezing water" as strongly bound water exhibiting no peaks on a thermogram down to -100oC. In light of this, applicants submit that the term is adequately defined to meet the description requirement.

With respect to claim 27, an amendment has been made to overcome the Examiner's rejection based on lack of antecedent basis.

D. Conclusion

In view of the above amendment and remarks, Applicants respectfully submit that the rejections set forth in the Office Action of February 26, 2002 have been overcome. Accordingly, Applicants submit that claims 12-30 are in condition for allowance. Withdrawal of the rejections and early notification of allowability are earnestly solicited. Should any issues remain, the Examiner is encouraged to contact the undersigned to resolve any such issues.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification

Please insert the following sentence on page 1, between the title and the first line of the disclosure:

--This application is a 371 of PCT/IL99/00097 filed February 16, 1999--

In the Claims

12. (amended) A method for the production of nanomaterial particles comprising the steps of:

synthesizing nanomaterial particles in solutions of complex liquids from suitable precursors, which precursors are selected from the group consisting of suitable surfactants, [and] alkoxides, and metal salts, by a suitable chemical reaction under mild conditions; and

preparing fine colloids dispersed in various polymer solutions.

27 (amended) A method according to claim 12, wherein [metal oxides and metal] the precursors are selected from the group consisting of triethoxy silanes (TEOS); trimethoxy silane (TMOS); Al[,] and Zr isopropoxides; Fe, Mg and Al chlorides; Al and Mg acetates; Na and K orthosilicates; Zr oxycholoride; and transition metal salts of Fe, Co, Ni, Cu, Ru, Rh, Pd, Ir, and Pt.